



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Hae-Kyoung KIM

Art Unit: 1745

Serial No. 09/931,862

Examiner: T. Dove

Filed: August 20, 2001

**Attorney 249/274
Docket No.**

**For: REINFORCED COMPOSITE IONIC CONDUCTIVE
POLYMER MEMBRANE AND FUEL CELL
ADOPTING THE SAME**

**DECLARATION OF DR. HAE-KYOUNG KIM
PURSUANT TO 37 C.F.R. §1.132**

I, Dr. Hae-Kyoung Kim, do hereby declare and state as follows:

- 1) I am the sole inventor of the above-captioned patent application.
- 2) I received a Bachelors of Science degree in Material Science and Engineering in March, 1991 from Pohang University of Science and Engineering in South Korea, a Masters of Science in Material Science and Engineering in December, 1994, and a Ph.D. in Materials Science and Engineering in December, 1998, from Illinois Institute of Technology. I have been employed by Samsung Advanced Institute of Technology as a research staff in South Korea since November, 1998.
- 3) The following experiments were carried out by me or under my direct supervision. These experiments were carried out to show the differences between embodiments of the present invention, which include a reinforcing agent that is not a part of, or an additive to the ion-exchange polymer, and prior art that discloses ion exchange polymers having additives that the United States Patent and Trademark Office alleges are reinforcing agents.

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Embodiments of the Present Invention (Ionomer/PVDF + SiO₂)

6 g of Polyvinylidenefluoride copolymer (PVDF), 3g of SiO₂, 50g of acetone, and 6g of dibutyl phthalate (DBP) were milled using a ball-mill process, and then cast to obtain a membrane. The membrane was soaked in ether, extracting and then removing the DBP from the resulting mixture to thus form a porous membrane. A mixture including 1 g of Nafion 115 (commercially available from DuPont) and 19 g of ethanol were coated on the porous membrane and then dried to form a reinforced composite ionic conductive polymer membrane.

Reference 1 (Ionomer/PVDF)

6 g of PVD, 50 g acetone, and 6 g of DBP were milled using a ball-mill process, and then cast to obtain a membrane. The membrane was soaked in ether, extracting and then removing the DBP from the resulting membrane to form a porous membrane. A mixture containing 1 g of Nafion 115 and 19 g of ethanol were coated on the porous membrane and then dried to form a composite ionic conductive polymer membrane.

Reference 2 (Ionomer + SiO₂/PVDF)

6 g of PVDF, 50 g acetone, and 6 g of DBP were milled using a ball-mill process, and then cast to obtain a membrane. The membrane was soaked in ether, extracting and then removing the DBP from the resulting membrane to form a porous membrane. A mixture containing 1 g of Nafion 115, 0.05 g SiO₂, and 19 g of ethanol were coated on the porous membrane and then dried to form a composite ionic conductive polymer membrane.

Experiments and Results

PEMFCs were manufactured in the same manner as Example 12 of the present invention, except that the composite ionic conductive polymer membranes of the present invention, reference 1 and reference 2 were used, respectively. Cell efficiency was evaluated for each of the PEMFCs manufactured above by measuring variations in cell potential with respect to current density. The results are shown in the attached Figure 1.

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The results shown in Figure 1 reveal that a reinforced ionic conductive polymer membrane prepared in accordance with the invention provides unexpectedly superior results, when compared to comparative membranes that are closer to the invention than the membranes disclosed in the prior art cited in the above-captioned patent application. The inventive membranes were prepared using a separate reinforcing agent, whereas the reference 2 sample was an otherwise identical membrane, except it was prepared by adding the reinforcing agent to the ion-exchange polymer as an additive.

4) I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

2009 - Feb. 1.

Date

Hae-Kyoung Kim

Dr. Hae-kyoung Kim